UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

January 30, 2002

MEMORANDUM

SUBJECT: Agency Response to Phase III Comments on Lindane

FROM: Mark T. Howard
Chemical Review Manager
Special Review Branch

TO: OPP Public Docket for Lindane (OPP Docket # 34239)

The attachments to this memo address comments received in response to EPA's Notice of Availability of revised risk assessments for lindane (66 *FR* 168, August 29, 2001). The *Federal Register* Notice 60-day public comment period ran from August 29 - October 29, 2001.

There are four response memos attached: A, B, C, and D. Attachment A, from the Special Review and Registration Division (SRRD), responds to general comments. Attachment B, from the Health Effects Division (HED), addresses comments on the human health risk assessment. Attachments C and D, from the Environmental Fate and Effects Division (EFED), address comments on the environmental risk assessment from the public and the registrants, respectively. Finally, there is an Attachment E that lists all the names of stakeholder groups who submitted comments.

APPENDIX A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

January 30, 2002

MEMORANDUM

SUBJECT: Agency Response to Phase III Comments on Lindane

FROM: Mark T. Howard
Chemical Review Manager
Reregistration Branch 3

TO: Lois Rossi, Director
Special Review and Registration Division

The Agency received a broad range of comments on the preliminary risk assessment of lindane from registrants, private citizens, state and local government agencies, non-profit environmental and consumer groups, Canadian canola growers and seed treaters, and commodity-based associations. A total of 1,327 comments were received by OPP docket during lindane's (Phase III) public comment period

Phase IV (revisions to the risk assessments and response to public comments) is now complete and the docket will re-open for an additional 60-day public comment period (Phase V) later this month. The final phase, Phase VI, will begin in March after the docket closes.

This document addresses general comments submitted by the public. In a separate memo HED addressed comments on the human health risk assessments and EFED submitted two response to comments memos (one responding to public comments, the other to the registrants' comments) addressing the environmental risk assessment. These will be collated and sent to the OPP docket for lindane, along with a list of stakeholder groups who have submitted comments.

APPENDIX A

1) Public Comments on incorporating lice and scabies treatment into EPA's Human Health Risk Assessment.

Numerous commentors stated that EPA's risk assessment of lindane would be incomplete without the inclusion of the pharmaceutical use of lindane as a lice and scabies treatment. Most of the commentors were aware that FDA (Food Drug Administration) regulates this use.[1] [2] The commentors frequently cited the Food Quality Protection Act (FQPA) and its mandate that EPA aggregate[3] the risks from all human exposures to a chemical as a requirement for consideration in the Reregistration Eligibility Decision (RED) of lindane. Most commentors requested the rules (i.e., the US Code of Federal Regulations) be amended so that EPA could work together with FDA on the assessment of aggregate risk of lindane use.

1) Response:

The Agency acknowledges this concern for the pharmaceutical use of lindane. However, the Agency is still exploring this issue.

Further information on FDA and how it regulates lindane can be obtained from its website: www.fda.gov; e.g., http://www.fda.gov/bbs/topics/ANSWERS/ANS00725.html.

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[1]Under FFDCA (The Federal Food, Drug, and Cosmetic Act), FDA approves and enforces the use of pesticides for human ectoparasites (which includes lice and scabies).

[2]At its creation in 1970, the Environmental Protection Agency initially regulated the use of pharmaceuticals/pesticides on humans until a Memorandum of Understanding (MOU) was signed between EPA and FDA in 1973 ceding that responsibility to FDA. This was later codified in the Code of Federal Regulations (see 40 CFR §152.20). The basis for the Agency's action was to avoid a redundant review of the safety of human applied pharmaceuticals containing pesticides.

[3]The terms aggregate and cumulative risk assessments have been the source of confusion to the public in regards to FQPA. An "aggregate" risk assessment under FQPA would look at the risk from one chemical from all exposure pathways for all uses of a chemical whereas a "cumulative" risk assessment would look at the risk collectively from similar chemicals expected to cause the same type of health effect in humans. Commentors typically asked for a cumulative risk to include lice and scabies treatments (FDA regulated uses) when they meant aggregate uses.

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2) Public comment on disposal of lindane from lice treatments.

Several commentors also expressed concern about the potential human health and environmental impacts from the disposal of lice and scabies treatments. These treatments are rinsed off (disposed of) into municipal sewers that do not effectively remove lindane before discharging their effluent to surface waters.

2) Response:

The Agency acknowledges the concern of the potential for lindane to contaminate surface waters after disposal in municipal sewer systems, including some surface waters that are used for drinking water. However, as noted in the response to comment 1 above, the Agency the Agency is still exploring this issue. Nevertheless, the Agency has funded two pollution prevention projects (in Region II and Region IX) to see if the pharmaceutical use of lindane can be altered or replaced with other treatments that are less persistent and/or less toxic to the environment. However, the Agency has not evaluated this release scenario to quantify the risk to human health or the environment.

3) Canadian canola grower and seed treaters' comments.

Many comments came from canola growers and canola seed treatment businesses in Canada. They urged that lindane be registered for use on canola in the US. Currently lindane use as a pre-plant seed treatment on canola is voluntarily suspended in Canada.

3) Response:

The EPA reregistration initiative focuses on currently regulated lindane uses. However, the proposed use of lindane on canola was evaluated along with current crops in the EPA reregistration risk assessment. The decision to register lindane for canola (seed treatment) use will be determined independently of the RED.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Office of Prevention, Pesticides and Toxic Substances

January 30, 2002

MEMORANDUM

SUBJECT: **Lindane**; Chemical No. 009001. HED's Response to Public Comment on HED's Revised Risk Assessment for Lindane Registration Eligibility Document (RED)

DP Barcode: D280623
Reregistration Case #: 0315

FROM: Becky Daiss
Environmental Health Scientist
Reregistration Branch 4/HED (7509C)

THROUGH: Susan Hummel
Branch Senior Scientist
Reregistration Branch 4/HED (7509C)

TO: Mark Howard/Betty Shackleford
Reregistration Branch 3
Special Review & Reregistration Division (7508C)

This provides the Health Effects Division's (HED) response to comments from the public on EPA's July 31, 2001 Revised Human Health Risk Assessment for Lindane (gamma-hexachlorocyclohexane). Comments were received from the following organizations: Natural Resources Defense Council (NRDC); Beyond Pesticides; World Wildlife Fund (WWF); Los Angeles County Sanitation Districts; Alaska Department of Environmental Conservation, Alaska Community Action on Toxics; Pesticide Action Network North America (PANNA); the Attorney General of the State of New York; Technology Sciences Group; and Inquinosa Internacional, S.A. A summary of the comments followed by HED's response is provided below. Sanju Diwan provided responses to comments pertaining to the toxicology assessment, Thurston Morton provided responses to comments on the residue chemistry and dietary assessments, and Becky Daiss responded to general risk assessment related comments.

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Comments on the Toxicology Assessment

Public Comment: NRDC stated that EPA's rationale for reducing the 10X FQPA margin of safety to 3X is deeply flawed because the six reasons the Agency has given are either incorrect or irrelevant for reducing the FQPA Safety Factor. The six reasons are: 1) the toxicology database is complete; 2) there is no indication of quantitative or qualitative increased susceptibility in rats from *in utero* exposure to lindane in the prenatal developmental study; 3) although the developmental toxicity study in rabbits was classified unacceptable, the HIARC concluded that a new study is not required; and 4) the offspring effects seen in the developmental neurotoxicity study were the same as those seen in the two-generation reproduction study (no additional functional or morphological hazards to the nervous system were noted).

HED Response: The Agency reduces or removes the FQPA Safety Factor if there is sufficient basis to conclude that the children are unlikely to be more susceptible to a given pesticide than adults. The Agency's rationale behind reducing the Safety Factor (SF) is as follows: 1) In the case of lindane, the database to assess the increased susceptibility under the FQPA is complete. These studies include prenatal developmental studies in rats and rabbits; reproduction study in rats, acute and subchronic toxicity studies in rats and delayed neurotoxicity in hen; as well as developmental neurotoxicity study in rats. The studies listed under "Data Needs" are those needed to fulfill the requirement of database to select hazard endpoints. Therefore, as far as assessment under the FQPA is concerned the database is complete. 2) The reproductive and developmental toxicity studies, both submitted by the registrant and those from the published literature and IPCS report, do not show strong evidence of increased susceptibility. The reproduction and developmental toxicity studies in rats submitted by the registrant show effects on fetuses at or above the dose that causes parental or maternal toxicity; however, there appears to be a qualitative difference in the severity of effects on fetuses versus maternal animals in the reproduction study. The developmental neurotoxicity study (DNT) is the only study which shows a quantitative increase in the susceptibility of infants since the effects occur at a dose that dose not cause toxicity to maternal animals, and the effects seen are the same effects as in reproduction study and, therefore, are confirmatory.

A 10X SF was reduced because a DNT study was available and showed some evidence of increased susceptibility of fetuses to lindane, however, these effects were not seen in the prenatal developmental studies; 3) The developmental toxicity study in rabbits was classified unacceptable; however, a new developmental toxicity study in rabbits is not required for the following reasons: a) The developmental toxicity study in rabbits and rats using a subcutaneous route of administration showed no developmental effects at the maternally toxic dose; b) The skeletal effects observed in the developmental toxicity study in rats, with gavage as the route of administration, were within historical controls values; c) More severe maternal effects are seen in the rabbit study with subcutaneous administration; d) The rat appears to be the more sensitive species for developmental effects; and e) A developmental neurotoxicity study has already been submitted. The FQPA Committee, therefore, determined that the **FQPA safety factor** be **reduced** to 3x. 4) Although the effects seen in a DNT are the same as in reproduction study, the

overwhelming information from the published literature and the results of prenatal studies do not provide evidence for an increase in the susceptibility of infants and children to lindane exposure.

Public Comment: Beyond Pesticides commented on the use of human versus non-human studies for determining carcinogenicity of lindane. The group noted that EPA is still reviewing a study to determine the carcinogenicity of lindane and urged EPA to complete the review process prior to determining reregistration as this may change the classification of this chemical.

HED Response: The OPP/Cancer Assessment Review Committee (CARC) has completed the review of newly submitted carcinogenicity study in CD-1 mice along with other data. In accordance with the EPA Draft Guidelines for Carcinogen Risk Assessment (July, 1999), the CARC has classified lindane into the category **"Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential"** based on an increased incidence of benign lung tumors in female mice only. The Committee, therefore, recommended that the quantification of human cancer risk is not required.

Public Comment: Several issues were raised with regard to the FQPA safety factor including : The Agency has failed adequately to justify the reduction of the tenfold FQPA safety factor to a threefold safety factor. The 10 fold safety factor should be retained for the following reasons: 1) The Agency has not considered the poisoning incidences with human exposure to lindane that may indicate increased susceptibility of children. The Agency has also ignored data on increased susceptibility of the young. The PDFR (2001) cites that animals studies indicate that potential toxic effects of lindane topical application are greater in the young. .....; 2) The statement that "the toxicological database is complete" is in conflict with the statement that "although the developmental toxicity study in rabbits was unacceptable, the Committee concluded that a new study is not required (p 15 of the revised risk assessment). In fact the EPA has listed 5 studies which are included as "Data Needs" (p. 48 of the revised risk assessment). 3) The effects seen in the developmental neurotoxicity study were the same as those seen in the two-generation reproduction study (p.15) provides further support for retaining the tenfold factor. 4) the Agency has underestimated potential exposures for infants and children to lindane, particularly from non-food sources such use in shampoos and lotions. This unaccounted exposure to lindane would greatly reduce the margin of exposure. 5) EPA did not conduct cumulative risk assessment by assuming that lindane does not have a common mechanism of toxicity with other chemicals although there is evidence of common mechanism of toxicity between lindane and malathion. 6) Since EPA has noted evidence of endocrine Disruptor effects, the reduction of the tenfold safety factor is not justified. 7) the tolerances should undergo full review to determine whether they are protective of infants and children under FQPA.

HED Response: The 10 fold safety factor was reduced to 3X for the following reasons: 1) The OPP has used human studies to select endpoints for risk assessment in the past. However, current Agency policy is that a regulatory decision cannot be made based on a human endpoint until a final policy regarding the ethical aspect of the use of human studies for regulatory purposes is issued. This approach was approved by the FIFRA Scientific Advisory Panel (SAP).

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The Agency is currently assessing the use of human studies to select endpoints for risk assessment. Therefore, for the lindane assessment, HED relied solely on animal data involving exposure to lindane to assess the increased the susceptibility of young versus adult and based on the weight-of-the-evidence the FQPA Safety Factor was reduced to 3X; 2) The toxicology database was complete for assessing increased susceptibility (refer to response to comment by NRDC above for further details) under the FQPA; 3) Although the effects seen in a DNT are the same as in reproduction study, the overwhelming published literature and the results of standard prenatal developmental toxicity studies do not support the evidence for an increase in the susceptibility of infants and children; 3) The studies listed under "Data Needs" are those that are necessary to fulfill the FIFRA data requirements in order to select hazard endpoints and not to conduct the FQPA assessment. For assessment under the FQPA the database is complete (refer to response to comment from NRDC for further details); 4) EPB claims that there is evidence of common mechanism of toxicity between lindane and malathion and that the cumulative risk should be assessed. Lindane and malathion both may cause similar target organ effects but probably by different mechanisms. Based on the review of unpublished and published literature on lindane toxicity, lindane does not seem to have a common mechanism of toxicity with other chemicals. 5) There are concerns that lindane may be an endocrine disruptor (ED), however there are no requirements for studies that address these effects at this time. EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there were scientific bases for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, lindane may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption; and 7) The tolerances for lindane have undergone a full review by the HED/MARC (refer to MARC, 1999 for details) and the Committee has determined that they are protective of infants and children under FQPA.

Public Comment: Alaska Community Action on Toxics' commented that the EPA risk assessment does not consider possible synergistic effects of lindane and other contaminants, such as cadmium.

HED Response: The Agency has not developed methods to assess synergistic effects among chemicals. The Agency is still developing methods to assess cumulative (additive) effects of chemicals with a common mechanism of toxicity. OPP considers possible cumulative effects of a

pesticide with other chemicals only if these chemicals share a common mechanism of toxicity. For example, currently OPP is considering cumulative effects of organophosphrous pesticides since they cause neurotoxic effects by cholinesterase inhibition. If HED identifies other substances that share a common mechanism of toxicity with lindane, HED will begin to conduct a cumulative risk assessment once the final guidance HED will use for conducting cumulative risk assessments is available.

Public Comment: The World Wildlife Fund stated that EPA should retain the 10X Safety Factor for lindane because lindane is a known endocrine disruptor. The lindane draft assessment ignores the significance of endocrine disruption due to delays in screening and testing implementation. The changes in 1996 guidelines for multi generation reproduction study added additional endpoints responsive to estrogenic and/or androgenic endocrine disruption which were not evaluated under the 1991 draft assessment.

HED Response: There are concerns that lindane may be an endocrine disruptor, however the agency has not yet developed methods to assess these effects. Although the 1996 guidelines for reproduction study included several parameters to assess endocrine effects, the available reproduction study was conducted according to pre-1996 guidelines. Until appropriate screens and assays to assess the endocrine disrupting effects are developed, the FQPA Safety Factor will be determined based on susceptibility of infants and children to lindane exposure. For further details, refer to response to comments from EPB).

Comments on the Chemistry Chapter and Dietary Assessment

Public Comment: There were a number of comments from the public on the dietary exposure assessment conducted for the indigenous people of Alaska. These mainly centered around the dietary intake used in the assessment.

HED Response: HED has identified additional studies and will revise the dietary assessment for the indigenous people of Alaska incorporating a diet which includes marine mammal tissue such as beluga whale blubber or ring seal blubber.

Public Comment: Technology Sciences Group Inc. on behalf of CIEL and Inquinosa Internacional, SA submitted comments regarding the Product and Residue Chemistry Chapter (D274754).

HED Response: HED has previously responded to most of these comments previously (S. Shallal, D274519, 6/14/01). The sole comment which has not been responded to pertained to product chemistry data which was submitted by the registrant and did not appear in the chemistry chapter. Once the product chemistry data is reviewed a memorandum will be sent to the registrant listing HED's conclusions and listing any additional data required.

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Public Comment: There were a number of comments from the public stating that previous uses of lindane should be assessed in the dietary exposure analysis.

HED Response: HED does not conduct dietary assessments incorporating past uses of a chemical which are now canceled and for which tolerances have been recommended for revocation. In addition, the USDA Pesticide Data Program (PDP) has analyzed over 20,000 samples of vegetables, fruit, milk, and grains from 1997 to 1999 and there were only 5 detections of lindane (maximum residue of 0.031 ppm).

Public Comment: One commenter stated that the beta isomer of hexachlorocyclohexane (HCH) should be assessed in the dietary exposure analysis also, due to the transformation of lindane (which is the gamma isomer of HCH) to beta hexachlorocyclohexane.

HED Response: HED believes the available data do not support significant isomerization of lindane (gamma-HCH) to beta-HCH in the environment. Therefore, HED will not include beta hexachlorocyclohexane in the dietary exposure assessment.

Public Comment: Exposure to lindane from fish consumption should not be limited to the indigenous population.

HED Response: There has been only 1 detection of lindane in fish in the FDA monitoring data program from 1992 to 1999. This detection was at a level of 0.006 ppm of lindane. Therefore, HED concludes it is appropriate to limit the exposure of lindane from fish consumption to the indigenous population of the U.S.

Comments on the Risk Assessment

Public Comment: A number of commenters raised concerns that EPA did not include a quantitative assessment of risks from exposure of children to lindane from direct application of the pesticide to their scalp or body for treatment of head lice or scabies. Commenters stated that FQPA requires that this source of exposure be taken into account.

HED Response: The risk assessment does not at this time include an assessment of risks from exposure to lindane from uses other than seed treatment.

Public Comment: The County Sanitation District of LA and others noted that the California Toxics Rule (CTR) establishes a criterion of 19 ppt lindane for protection of human health via consumption of water and aquatic organisms. Based on this criterion, both monitoring data and EPA's model generated EECs exceed the level of concern set by the CTR.

HED Response: The Maximum Contaminant Level Goal (MCLG) for lindane established by EPA's Office of Water is 0.2 ppb (200 ppt). An MCLG is defined as the level of contamination in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals. OW's Maximum Contaminant Level (MCL) for lindane is also 0.2 ppb. The MCL is an enforceable standard. The MCLG for lindane is based on EPA's assessment that short term exposure to lindane at levels above the

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MCLG potentially cause nervous system effects and chronic exposures above the MCLG have the potential to cause liver and kidney damage.

It is EPA's understanding that 19 ppt criterion established under the CTR is set based on potential lifetime cancer risk from long term exposure to lindane (www.epa.gov/fedrgstr/EPA-WATER/2000/May/Day-18/w11106.htm). Based on a recent review of the data, the Office of Pesticide Programs Health Effects Division (HED) has classified lindane into the category "Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential" because lindane caused an increased incidence of benign lung tumors in female mice only. HED's Cancer Assessment Review Committee (CARC) therefore recommended that human cancer risk not be quantified. EPA's Office of Water has similarly determined that there is inadequate evidence to state whether or not lindane has the potential to cause cancer from lifetime exposures in drinking water. Therefore, EPA believes that the Office of Water's MCLG of 0.2 ppm is the appropriate health based standard for lindane in drinking water sources.

Public Comment: NRDC and Beyond Pesticides stated that EPA should combine risk to workers from dermal and inhalation exposure to lindane.

HED Response: As a matter of policy, HED does not currently aggregate risk from dermal and inhalation exposures unless there is a common toxicological endpoint for each route of exposure.

APPENDIX C

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: EFED response to public comments regarding the DRAFT EFED RED chapter for **Lindane.** PC Code No. 009001; DP Barcode: D278985

TO: B. Shackleford, Branch Chief
M. T. Howard, Team Leader
Special Review and Reregistration Division (7508C)

FROM: N.E. Federoff, Wildlife Biologist, Team Leader
J. Melendez, Chemist
Environmental Risk Branch V
Environmental Fate and Effects Division (7507C)

THROUGH: Mah T. Shamim, Ph.D., Chief
Environmental Risk Branch V
Environmental Fate and Effects Division (7507C)

Lindane Docket Control No. OPP-34239

Comment 131: World Wildlife Fund (WWF): EFED agrees with the WWF that lindane is a potential endocrine disruptor and has incorporated information on the potential endocrine disrupting effects of lindane, especially in mammals, in the DRAFT RED Chapter. The information WWF provided regarding potential endocrine disruption in fish was interesting but no references were provided. EFED would like to point out that the terrestrial risk determined for lindane seed treatment was based on the assumption that the seed component of the animals diet consists exclusively (100%) of treated seed. In addition, the quantitative segment of the avian assessment does not take into account feeding preference or avoidance behavior toward treated seed, as these data are more of a qualitative nature and are included in the risk characterization section and may in fact mitigate risk to some extent. There were no such data available for mammalian species. In addition, the aquatic assessment was based on the assumption that 100% of the compound disassociates from the seed surface. These risks may be highly conservative and unrealistic due to this assumption. Thus, the Agency is requiring a seed leaching study to further characterize possible exposure.

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Comment 132: Inquinosa Internacional, S.A.: Comments are general in nature and do not affect EFED Ecological Risk Chapter.

Comment 146: Inquinosa Internacional, S.A.: This comment is identical to comment #132.

Comment 148: Beyond Pesticides.Org, J. Feldman, Exec. Director: Repetition of general facts from the DRAFT EFED RED Chapter. There is a citation of a half-life of 15 months for lindane (from the Extension Toxicology Network website, 1996). A search of the website indicated that the source of the information is Wauchope, R. D., Buttler, T. M., Hornsby A. G., Augustijn Beckers, P. W. M. and Burt, J. P. SCS/ARS/CES Pesticide properties database for environmental decision making. Rev. Environ. Contam. Toxicol. 123: 1-157, 1992.6-15. This half-life is in agreement with a high persistence indicated in our guideline study (our reported result was extrapolated with an aerobic soil metabolism half-life of around 30 months). In addition, a maximum contaminant level for lindane in drinking water was indicated to be 0.2 ppb. This issue is addressed in more detail in the response to Comment 152.

Comment 152: Los Angeles County (CA) Sanitation District, James Stahl, Paul Martyn, Industrial Waste Section: Primary concern is that the Agency's assessment is deficient and fails to take into account the environmental risk associated with the use of lindane in lice and scabies treatment: EFED agrees that lice and scabies treatment may affect risk, however this risk assessment does not at this time include an assessment of risks from releases to the environment of lindane from uses other than seed treatment (e.g., use of lindane to treat head lice or scabies).

The County Sanitation Districts of Los Angeles County contrast the Chronic (sic) EEC's at 0.67 ppb from GENEEC, 0.011 ppb from SCIGROW, the DWLOC of 14 ppb, and the EPA's allowable criterion for the protection of human health via consumption of water and aquatic organisms of 0.019 ppb. A maximum contaminant level for lindane in drinking water was indicated to be 0.2 ppb by Mr. Jay Feldman (Beyond Pesticides), comment 148.
The source for that information for the MCL is www.epa.gov/safewater/dwh/c-soc/lindane.html.

Available information to EFED at this time is as follows:

Surface Drinking Water

Concentration/ppb				
SW peak (GENEEC)	SW ave. 56 day, chronic (GENEEC)	SW peak (FIRST)	SW annual average, chronic (FIRST)	GW (SCIGROW)
0.67	0.48	0.59	0.28	0.011

Drinking Waters Limits Established by EPA

Concentration/ppb	
DWLOC	MCL
14	0.019 (0.2)

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The GENEEC results were reported earlier in the Draft Report. Since then, a new model, FIRST has become available to the Division and results were recalculated. All results were stated in the table above. It is noted that although none of the estimates of drinking water concentration exceed the DWLOC's for lindane, levels are higher than the MCL for the chemical for the estimates of concentrations in surface waters.

Comment 153: Northwest Coalition for Alternatives to Pesticides (NCAP) and Washington Toxics Coalition's Clean Water for Salmon Campaign: Comments specifically address the risk to salmon runs listed under the Endangered Species Act, and the habitat those fish need to survive: EFED agrees that lindane is toxic and may be an endocrine disrupting compound in fish. EFED also agrees that lindane is found in the environment due to past uses. The Agency is requiring the appropriate studies be conducted to cover the deficiencies outlined in the RED. Regarding aquatic risks presented in the draft chapter, aquatic risks were calculated with the assumption that 100% of the compound disassociates from the seed surface. These risks may be highly conservative and unrealistic due to this assumption. Thus, the Agency is requiring a seed leaching study to further characterize possible exposure.

Comment 154: Pesticide Action Network North America: Comments regarding residues in water. **A comment addresses the high bioaccumulation potential of Lindane:** The available information to EFED indicates that the chemical depurates "relatively" rapidly. EFED acknowledges, however, that chronic exposure of fish to this chemical could result in multiple detections in fish tissue, even if the levels of lindane are very low. Please see the EFED response under comment 152 regarding PANNA's water contamination issues.

Comment 157: **Comments from The National Resources Defense Council**: EFED agrees with the NRDC and has incorporated information on the potential endocrine disrupting effects of lindane, especially in mammals, in the DRAFT RED Chapter. Regarding our water resource assessment, we feel that without refinement and based on the assumption that 100% of the compound disassociates from the seed surface, the assessment may be highly conservative and unrealistic due to this assumption. Thus, the Agency is requiring a seed leaching study to further characterize exposure.

The possibility that Lindane can bioaccumulate in the food web was addressed in the EFED RED chapter (refer to response to comment 154 for additional information regarding this issue). Please see the EFED response under comment 152 regarding the NRDC's water contamination issues.

Comment 158: **Comments from Alaska Community Action on Toxics**: EFED agrees that lindane is found in the Arctic regions and can be deposited there in various ecological compartments through atmospheric and oceanic transport. EFED also agrees that lindane is a potential endocrine disruptor and has incorporated information on the potential endocrine disrupting effects of lindane, especially in mammals, in the DRAFT RED Chapter.

Comment 160: These comments are the same as were submitted by The Technology Sciences Group Inc. under DP Barcode: D274510 and will be addressed in a separate memo.

APPENDIX D

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Response to registrant comments on the EFED RED chapter for **Lindane**
PC Code No. 009001; DP Barcode: D274510

TO: B. Shackleford, Branch Chief
M. T. Howard, Team Leader
Special Review and Reregistration Division (7508C)

FROM: N.E. Federoff, Wildlife Biologist, Team Leader
J.L. Meléndez, Chemist
Environmental Risk Branch V
Environmental Fate and Effects Division (7507C)

THROUGH: Mah T. Shamim, Ph.D., Chief
Environmental Risk Branch V
Environmental Fate and Effects Division (7507C)

The registrants (CIEL and Inquinosa) have submitted comments through McKenna & Cuneo, L.L.P. prepared by Technology Sciences Group Inc. (TSG) regarding EFED's environmental fate and effects RED chapter for lindane.

Summary of Submission
The comments from the registrant were in two basic categories: 1) Environmental Fate and 2) Ecological Toxicity and Risk Assessment (both terrestrial and aquatic). A document, in the form of a position paper, regarding atmospheric transport and stability of lindane, was also attached.

I) Environmental Fate Comments

CIEL indicated that the statement, "Lindane is persistent and moderately mobile," is misleading. Additionally, the registrant has objected the identification of lindane as a POP ("Persistent Organic Pollutant"). The registrant argues that lindane is not persistent since in two field dissipation studies, three half-lives in the range of 25-107 days were obtained. EFED offered a concise statement based on the overall picture that the pesticide lindane provides. The picture was based on laboratory and field studies submitted to the agency, published literature, and

monitoring data. The major indicator of the persistence of a pesticide is usually the aerobic soil metabolism study. The available valid study (MRID# 406225-01) was conducted on a sandy loam soil for 336 days. This study indicated very slow degradation (mostly soil binding), with an extrapolated half-life of about 980 days.

The field studies provide an estimate of the amount of pesticide remaining on the soil surface but they do not provide detailed information about all the processes involved in the dissipation of the pesticide. In a field, many competing processes may occur simultaneously, such as (but not necessarily limited to) volatilization, horizontal movement via runoff events and vertical movement via leaching. In all these processes it appears that the pesticide can remain intact, i.e., undegraded. The laboratory studies did not show any important route of degradation. Thus EFED rightfully described the pesticide as persistent.

The registrant indicated that the phrase, "It...degrades very slowly by microbial actions," is not factual. EFED acknowledges that an anaerobic soil metabolism study submitted by the registrant was not referenced in the draft document (MRID# 44867102). The study provides at best supplemental information on the anaerobic behavior of lindane, but the study has serious deficiencies that make the interpretation of the results very difficult. The major deficiencies are the poor recoveries of the total radioactivity, which were <90% at all test intervals except the initial and day 14 of the aerobic incubation. At the end of the anaerobic incubation, the total average recovery had decreased to about 72% of the applied. In addition, data were highly variable. The registrant believes that the reason for the poor recoveries was loss of volatile material, but other possibilities were not explored. Based on the data available, the apparent degradation or dissipation half-life of lindane under anaerobic conditions was 45 days. EFED is not confident in the data obtained in this study due to the major deficiency found in it. In addition, the registrant provided another study, MRID# 44867107, which is a non-guideline study. With respect to the aerobic metabolism, please, refer to the following comment.

The registrant proposed that "the longest calculated half-life for lindane in aerobic soil was 88 days." The registrant refers to the aerobic incubation portion of the same anaerobic soil metabolism study mentioned above (MRID# 448671-02). EFED does not consider these data useful for the following reasons:

An insufficient number of test intervals were taken during the aerobic phase of the study: these were initial, 14 days, and 31 days.

The aerobic portion of the test lasted only 31 days. This period is correct, as specified for the anaerobic soil metabolism study, but it is too short for an aerobic soil metabolism study, which should be conducted for at least three half-lives, or, according to the current guidelines, for a year. The calculated half-life was extrapolated at 88 days.

The total recoveries decreased substantially in the short period of aerobic incubation (the average recovery was about 86% at 31 days of aerobic incubation).

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The registrant indicates that the statement, "Degradates are primarily isomers of benzene hexachloride, pentachlorocyclohexane...," is incorrect, and objects that there is the possibility of formation of alpha and beta isomers of hexachlorohexane by biological or phototransformation. EFED acknowledges that the soil and aqueous photolysis studies indicated very little if any photolysis/photodegradation under the stated conditions. In the aerobic soil metabolism study pentachlorohexene and -HCH were present and were identified correctly as minor components in the original review (3.84%, additional characterization about pentachlorohexene follows with the next comment).

As part of the completion of this response, the available anaerobic soil metabolism study was revised. Although the study had major problems, some information could be derived. The study shows the presence of one major metabolite (>10%) at 11.8% of the applied radioactivity after 60 days of anaerobic incubation in the XAD-2 trap (2.5% of the applied recovered after 30 days of anaerobic incubation, added to 4.8% after 45 days, and 4.5% after 60 days). The registrant attempted to identify the degradate. It eluted on GC trials at 10.1 minutes. When the sample was spiked with -HCH, it eluted with the unknown, suggesting the presence of -HCH. However, this could not be confirmed by a second analytical technique, namely HPLC. Although the results were not definitive, based on the known characteristics of this chemical, and the supplemental results of the anaerobic soil metabolism study, it appears that there is a high possibility of the formation of -HCH under some circumstances. The EFED chapter will be revised to address more accurately this issue.

The registrant objects the identification of pentachlorocyclohexene and -BHC as minor degradation products in the aerobic soil metabolism study. According to the registrant, such compounds were present at the beginning of the study. The study referenced is MRID# 406225-01 (mentioned above). It was confirmed that both compounds were present at the beginning of the study; however, it was observed that, even though there was some variability in the data, pentachloro-cyclohexene (PCCH) showed a continuous increment in concentration from day 0 to day 336 (last test interval) of the study. In general, it appears that there is metabolic transformation during the study, where pentachlorocyclohexene is formed slowly. It is also noted that the registrant itself identifies PCCH as a metabolite. In the Summary (page 1 of 101 of their report), the registrant indicates, "Autoradiographic analysis of thin layer chromatography (TLC) of organic solvent extracts showed that the 2,3,4,5,6-pentachlorocyclohexene (PCCH) was the major metabolite in the soil." Furthermore, in their position paper (Attachment A), the registrant presented a brief summary of available literature information in their response to the Draft EFED Chapter. Their conclusion paragraph is consistent with what EFED stated in the chapter (page 29 of 34): "These studies give a consistent message that although microbial transformation of lindane to -HCH is technically possible, it does not occur to a significant extent. Although lindane can isomerize to -HCH by both photolysis and microbial degradation, significant conversion under typical environmental conditions has not been demonstrated for either pathway."

The registrant also objects some inferences made by the team related to the terrestrial field dissipation study conducted in California. EFED believes that the inferences presented in the summary of this study are appropriate. In essence, the registrant is presenting a different scientific opinion over the same data set than that of EFED.

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EFED agrees that widespread contamination of ground water with lindane is not expected to occur. The overall assessment did not overemphasize lindane occurrence in ground water. However, lindane was detected in approximately 0.1% of wells sampled by the NAWQA study, at 0.01 g/L. The Division considers that percentage relatively high, considering that lindane is not a naturally occurring compound. Where soils are permeable, particularly where the water table is shallow, lindane may result in ground-water contamination. Finally, it is noted that the EFED did not recommend a label advisory for ground water.

A second terrestrial field dissipation study, submitted in 1988, was inadvertently omitted. The study (MRID# 406225-02) was conducted in Georgia. The results of this study tend to corroborate the overall picture described previously, using all the other environmental fate studies. It does not substantially change the Risk Characterization.

The registrant indicated that the Tier I screening assessment using GENEEC was performed with "unreasonable (sic) **value" for the soil metabolism. Furthermore, the soil incorporation depth should have been 2 inches instead of 1 inch.** EFED points out that the aerobic soil metabolism study now deemed "unreasonable" by the registrant was accepted as valid on 8/21/89 (12 years ago), and it has been supported by the registrant since then. GENEEC is used as Tier I model for screening assessment. The registrant is reminded that the Division guidelines indicate that when there is only one aerobic soil metabolism study usually three times the available value is the input for both models (FIRST and GENEEC2). Since the available value indicates high persistence of lindane, and it is an extrapolated value, the team chose not to multiply it by three.

EFED recalculated the surface water values using 2 inches soil incorporation, and the improved models: FIRST (drinking water), and GENEEC2 (ecological effects). It was found that the effect was not significant. Results are as follows:

	Concentration/ppb			
GENEEC	peak	average 4 day	average 21 day	average 56 day
	0.67	0.66	0.58	0.48

	peak	annual average
FIRST	0.59	0.28

	peak	max. 4 day ave.	max. 21 day ave.	max. 60 day ave.	max. 90 day ave.
GENEEC2	0.56	0.56	0.55	0.52	0.5

It is noted that although none of the estimates of drinking water concentration exceed the DWLOC's, levels are higher than the MCL for lindane for the estimates of concentrations in surface waters. The MCLs are determined by the Office of Water.

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The registrant indicated that the ground water concentration was calculated with a maximum application rate of 0.06 lb a.i./A. The actual maximum application rate is for wheat, at 0.051 lb a.i./A. Table 5 in the report indicates that the input parameter was 0.06 lb ai/A. Inspection of Appendix III shows, however, that the correct input parameter was used. Table 5 will be corrected to reflect the input parameter used. The reported result is not affected.

Monitoring Data: The registrant is requesting that EFED use "NAWQA" and "STORET" data to assess risk to aquatic organisms and to support the assertion that current uses of lindane do not produce residues of concern in surface and ground waters. EFED disagrees and would like to stress some basic general parameters that should be considered when using these types of monitoring data:

EFED believes that utilizing "NAWQA" and/or "STORET"data exclusively to establish exposures or to define aquatic risk is not appropriate in most cases. Both databases indicate that lindane has been found in surface and ground water. There is no indication from the available monitoring data, or the registrant's rebuttal, that this has changed.

The models used by EFED (FIRST and GENEEC2) assume the chemical is applied in the area surrounding the water body from which exposures may occur. Random monitoring of agricultural areas does not automatically assure that lindane was used in the basin surrounding the body of water being sampled. Neither NAWQA nor STORET monitoring programs are designed or are intended to establish potential risk to aquatic organisms from agricultural chemicals.

The NAWQA monitoring program is not designed, nor is it intended to establish potential risk to human health. NAWQA is a status and trends program for general water quality. Monitoring is not "targeted" to specific pesticides and no validated link to a pesticides' use at the field level with an occurrence in either ground or surface water has been made.

The Agency's inferences, presented in the Draft Document were general (as opposed to very specific). The Agency acknowledges that lindane's use has decreased over time, and detections should decrease accordingly, but, once again, the purpose of the estimation of EEC's is to obtain potential concentrations of a pesticide when they are applied in the proximity of surface water intakes.

NAWQA data are limited by the extent of sampling conducted at any one site. Very few sites were sampled more than a few times in a year and still fewer for more than one year. The registrant should be referred to the recently published International Life Sciences Institute's working group report "A Framework for Estimating Pesticide Concentrations in Drinking Water for Aggregate Exposure Assessments" for guidance on the recommended minimum data sets necessary for estimating drinking water exposures for human health risk assessments. The registrant is encouraged to further evaluate the correlation between known lindane use and the occurrence data available through the monitoring sources. Information such as, but not limited to, the timing of lindane application, proximity to the sampling site and proximity of sampling

site to the nearest drinking water intake are necessary to better characterize the usefulness of the monitoring data.

II) Ecological Toxicity and Risk Assessment Comments

The registrant's main rebuttal points were that exposure to wildlife was grossly overestimated, submitted avian aversion data and field data (Blus et al. 1984, 1985) were ignored in estimating exposure, further aquatic organism toxicity studies are not needed, and the overall assessment and data used were not appropriate.

The exact impact of seed treatments on environmental exposure is difficult to assess because of the variability of seed application methods as well as uncertainty of fate and transport processes near the seed coat or the plant root zone (rhizosphere). In general, the depth of seed incorporation is directly proportional to seed size; the smaller the seed the more shallow the soil incorporation. Soil incorporation depth of seeds can range from surface application for hydroseeded applications of grass seed to a 2 inch incorporation of corn seed using ground equipment. The uniformity of the seed incorporation depth, however, is likely to be dependent on the roughness of the soil surface. (EFED Policy Guidance for Ecological Risk and Drinking Water Assessments of Seed Treatment Pesticides; Memorandum from D. Keehner 7/30/99).

The risk determined for lindane seed treatment was based on the assumption that the seed component of the animals diet consists exclusively (100%) of treated seed. In addition, the quantitative segment of the avian assessment does not take into account the USFWS field studies (Blus et al., 1984, 1985), feeding preference or avoidance behavior toward treated seed, as these data are of a qualitative nature and were included in the risk characterization section. If these data were ignored as the registrant has stated, they would be completely absent from the entire document. Also, not all potentially exposed avian species were tested for avoidance so it is unknown if this behavior encompasses all species. In addition, since there were no such data available for mammalian species, no inferences can even be made regarding any feeding preference or avoidance behavior. The USFWS field studies (Blus et al., 1984, 1985) are suggestive of avian aversion for a broad range of species under actual seed treatment use and this was stated in the draft chapter.

The registrant suggests that an LC50 should be used as the toxicity endpoint instead of an LD50, which EFED used in assessing the risk of lindane to birds and mammals. EFED used an LD50 for a number of reasons:

First, the data were available for a number of avian species (a range of 5 species), where no extrapolations were needed, providing a more realistic assessment, in terms of actual toxicity data for those specific species.

Secondly, EFED has found that the LD50 value is often a better indicator of acute toxicity to birds for acutely toxic pesticides. Also, Hill (1994) points out that ingestion is believed to be the most common route of avian exposure to pesticides (as is the case with lindane treated seed) and the LD50 provides a sound basis for preliminary screening. In acute oral toxicity studies conducted on mallard duck, bobwhite quail, starlings, red-winged blackbirds and sparrows, the

LD_{50s} for lindane were 2000, 122, 100, 75 and 56 mg/kg, respectively. Subacute dietary toxicity studies conducted on mallard duck, bobwhite quail, ring-necked pheasant, and Japanese quail suggest that lindane is practically non-toxic to highly toxic, with LC_{50s} of >5000, 882, 561 and 425 ppm, respectively. These results suggest that lindane toxicity seems to be correlated with avian body weights and is more toxic to birds with smaller body weights.

The registrant suggests that the terrestrial risk assessment methods were not appropriate. The labels with the highest rates (lb lindane/100 lb seed) were used to evaluate potential maximum consumption of lindane by terrestrial animals. The current approach used daily food intake calculated using the relationships described in Nagy (1987 as cited in USEPA, 1993). Acute risk quotients (RQ) were then calculated based on animals receiving their full diet from lindane-treated seeds for a 1-day time period–that is,

$$\mathbf{RQ} = \frac{\textbf{mass of lindane consumed in 1 day from treated seeds}}{\textbf{species-specific mass of lindane required to reach } \mathbf{LD_{50}}}$$

EFED was interested in knowing how much lindane was on the seed, how many seeds were needed to reach the LD50 level and was the animal capable of consuming that # of seeds. The assessment was based on the assumption that 100% of the organisms diet consisted of treated seed and that these seeds, although soil incorporated, were 100% available for ingestion as a food item, not as a granule. Potentially, all seed may be available to some species and with the limited data set, we may be overestimating risk to some and underestimating risk to others. Using 1 % seed availability on a per acre basis is thus an erroneous assumption, especially for small mammals. On the contrary, seeds are food items and once found, avian and especially mammalian seed eating species will likely actively search for more. Granular products are not food items and it is likely that ingestion would be incidental or picked up as grit accidently and not actively searched for as forage.

The registrant requests a waiver for all further toxicity studies with aquatic organisms based on the following five reasons:

Registrant calculated exposure values are less than those in the RED.
Additional dilution in estuarine environments compared to freshwater systems.
Pink and brown shrimp data should not be used as the most sensitive species and are outliers.
Limited exposure period.
Low acute to chronic ratios (ACRs).

EFED partially agrees with the registrant. As stated in the DRAFT RED document, EFED believes the aquatic EECs are likely very conservative. The modeling assumption that 100% of the compound will disassociate from the seed surface has likely produced highly conservative estimates and has thus overestimated the EEC's and resulting risks. EFED believes that a seed leaching study would greatly increase certainty regarding a more realistic estimate of the amount of available lindane on the seed surface and leaching from the seed surface. This in turn would allow a refinement of exposure estimates and environmental concentration values (EECs).

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Regarding the suggestion that the shrimp data should not be used, EFED uses the most toxic data available as a "worst case scenario", thus trying to protect all potentially exposed species. There may in fact be other organisms that lindane may be even more toxic to than the current data presents.

In light of the facts above, these studies may be held in reserve until a seed leaching study is submitted and a determination for further submissions will be accomplished at that time. Without these data, more realistic environmental concentration estimations and risk determinations would not be able to be calculated with any degree of certainty.

The registrant requests a waiver for all further toxicity studies with terrestrial organisms. The submitted study (MRID 448671-01) was classified as being supplemental due to guideline deviations as well as the low hatching success in the control group. The low hatching success in the control group may have influenced the power of the test to detect significant effects. Thus, the study should be repeated to determine if 15 ppm is a valid NOAEL value. The NOAEL value of 15 ppm will be used in risk assessments until further data is provided.

Seed leaching study
The registrant is unclear as to the definition of the submission request for a seed leaching study and seeks additional guidance. EFED has attached the standard method of determining the leachability of pesticides from treated seeds document (Memo from D. Keehner, Standard Method of Determining the Leachability of Pesticides from Treated Seeds, 7/6/2000).

The registrant requests that all inferences to lindane as an endocrine disruptor be deleted from the chapter due to no evidence found in the submitted toxicological studies. EFED strongly disagrees due to the large amount of data in the literature suggesting that lindane is a potential endocrine disrupting compound.

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References

Memo from D. Keehner, Acting Director, EFED. 7/30/99. EFED Policy Guidance for Ecological Risk and Drinking Water Assessments of Seed Treatment Pesticides.

EFED Science Policy Panel, M. Frankenberry, Chair, Memo to D. Keehner, Acting Director, EFED. 7/7/2000. EFED policy for conducting screening level avian risk assessments for spray applications of pesticides.

Memo from D. Keehner, Acting Director, EFED. 7/6/2000. Standard method of determining the leachability of pesticides from treated seeds.

Blus, L.J., C.J. Henny, and A.J. Krynitsky. 1985. The effects of heptachlor and lindane on birds, Columbia Basin, Oregon and Washington, 1976-1981. Science of the Total Environment 46:73-81.

Blus, L.J., C.J. Henny, D.J. Lenhart, and T.E. Kaiser. 1984. Effects of heptachlor and lindane treated seed on Canada geese. Journal of Wildlife Management 48(4):1097-1111.

Hill, E. F. 1994. Acute and subacute toxicology in evaluation of pesticide hazard to avian wildlife. Pages 207-226 in R. J. Kendall and T. E. Lacher, Jr., editors. Wildlife Toxicology and Population Modeling: Integrated Studies of Agroecosystems. SETAC Special Publication Series. Lewis Publishers, Boca Raton, Florida. 576 pp.

USEPA. 1993. Wildlife exposure factors handbook (Volume I). EPA/600/R-93/187a.

Appendix E

List of organizations submitting comments (by type of group):

Technical and Product Registrant and Task force comments:
C.I.E.L. (Centre Internationale D'Etudes du Lindane)
Gustafson Partnership
Canola & Speciality Crops Products
INQUINOSA Internacional
Technology Sciences Group, Inc. for Uniroyal

State and local government agencies comments:

Washington State Dept. of Health
Tri-Tac
Sanitation Districts of Los Angeles
Alaska Dept. of Enviro. Conservation
Attorney General of New York

Comments from Universities:
Florida Atlantic University

NGO commentors:

Safe2Use News
Informed Choice

VPIRG

National Pediculosis Association

Beyond Pesticides

N.W. Coalition for Alternatives to Pest.
Pesticide Action Network North America

NRDC (and on behalf of several other organizations)
Alaska Comunity Action on Toxics (ACAT)

Dragasani Hospital
Rural Action Safe Pest Control Program

Agricultural growers associations:

Canola Council of Canada
Manitoba Canola Growers Assoc,

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List of Canadian seed treaters and farms commenting:

Cort Seeds & Greenhouses
Kintyre Farms, Ltd.
Markert Seeds, Ltd.
South Peace Grain Cleaning Co-OP

Spruceheld Agricore
Sturgeon Valley Fertilizers
Elo Seeds
Battle River Seed Cleaning
KIBA Seed Plant
Mercer Seeds, Ltd.
Hussin Seed Farm
Keystone Agricultural Producers
Manitoba Canola Growers Assoc.
World Wildlife Fund
Inquinosa Iternacional
Strome Co-Op Seed Plant
Stettles Soy
Stickland Farms
Blue Sky Seeds, Ltd.
Crawfoot Agri Supplies
Crowfoot Agri. Supplies
Hawksdale Farm
Undholm Seed Farm
Strome
Redfern Farm Services
Prairie Seeds, Inc.
Boyes Seeds
Valleau Seeds, LTD
Kostenuk Seeds
Ostafies Seed Farm
Cahora District Seed Cleaning Co-op
Clancy Seeds, Ltd.
Fedoruk Farms Inc.
Ardell Seeds Ltd.
New Fiber Farms
K & K
Lug Seeds
Berschoid Bros. Seeds
Redfern Farm Services
Jego Farms Ltd.
Gurba Seed Farms
Crystal Viwe Seeds, inc.
Nadan Reliable Sees Service
Greenfield Agro Services
Court Seeds & Greenhouses
Mantei Seed Cleaning Services
Forostburg Co-Op Seed Cleaning Plant
Wagner Seed Farm, Ltd
Cameron Seeds
Plehsington Colelee Farms

Illingworth Seeds
Witting Seed Plant
Cay Seeds
Agriteam
Lepp Seeds
Spilutions
Lashburn Ag Ventures
Allan Seeds, Ltd
Argail Enterprises
Vermillion Seed Cleaners Assoc.
Redfern Farm Services
H & T Processing
Parcenin Holdings Ltd
Friendly Aeirs Seed Farm, Inc
Norteatern Seed Co., Ltd
Fenton Seed Farm, Ltd
Nemet Seed Processing
Seed Cleaning Assoc,
Coronation Seed Cleanng Co-op, Ltd